FIELD DEMONSTRATION OF ENHANCED SORBENT INJECTION FOR MERCURY CONTROL

QUARTERLY TECHNICAL PROGRESS REPORT

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LIST OF ABBREVIATIONS

AC	activated carbon
BOP	balance of plant
DOE	U.S. Department of Energy
EERC	Energy and Environmental Research Center
ESP	electrostatic precipitator
NETL	National Energy Technology Laboratory
NDIC	North Dakota Industrial Commission
PRB	Powder River Basin
SCA	specific collection area

Executive Summary

ALSTOM Power Inc, Power Plant Laboratories (ALSTOM-PPL) has been awarded a consortium-based, DOE-NETL program to demonstrate Mer-Cure™ technology, ALSTOM-PPL's novel and oxidation-based mercury control technology in coal-fired boilers. In the program, ALSTOM-PPL teams up with the University of North Dakota – Energy and Environmental Research Center (EERC), PacifiCorp, Basin Electric Power Cooperative (Basin Electric), Reliant Energy, North Dakota Industrial Commission (NDIC), and Minnkota Power.

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The full-scale demonstration program consists of three seven-week long test campaigns in three independent host sites firing a wide range of coal ranks. These host sites include PacifiCorp's 110-MW_e Dave Johnston Unit 1 burning a Powder River Basin (PRB) coal, Basin Electric's 220-MW_e Leland Olds Unit 1 burning a North Dakota lignite and its blend with a PRB, and Reliant Energy's 170-MW_e Portland Unit 1 burning an Eastern bituminous coal. These boilers are all equipped with an electrostatic precipitator (ESP).

In Mer-Cure™ technology, a small amount of sorbent (Mer-Clean™) is injected into a flue gas stream environment where the gaseous elemental mercury oxidation and removal is favorable. The sorbents are prepared with chemical additives that promote oxidation and capture of elemental mercury.

The Mer-Cure™ mercury control technology offers a great opportunity for utility companies to control mercury in the most cost-effective manner while minimizing any balance-of-plant impact. ALSTOM also believes that the DOE-sponsored full-scale demonstration of the technology will accelerate our commercialization effort of Mer-Cure™ technology.

ALSTOM-PPL's accomplishments during the first reporting period are:

- Signed Confidentiality Agreements with the project team members.
- Started design, engineering and fabrication of Mer-Cure™ system.
- Scheduled a site visit to PacifiCorp's Dave Johnston Station, the first demonstration site.
- Executed Host Site Agreement with Basin Electric.
- Executed Subcontract Agreement with UND-EERC.
- In the process of completing Host Site Agreements with other host sites.
- In the process of negotiating Subcontract Agreements with host sites.

INTRODUCTION

Over the last three years, ALSTOM-PPL has developed Mer-Cure™ technology, a cost-effective mercury control technology for coal-fired utility boilers. In Mer-Cure™ technology, carbon-based sorbents are prepared by treating activated carbon with a small amount of chemical additives that promote oxidation and capture of elemental mercury. The treated sorbent is then processed and injected into a flue gas stream where the gas environment can significantly improve mercury capture.

The overall objective of the project is to perform full-scale demonstration of Mer-Cure™ technology in three coal-fired boilers burning coals of various ranks. These host sites include PacifiCorp's 110-MW_e Dave Johnston Unit 1 burning a PRB coal, Basin Electric's 220-MW_e Leland Olds Unit 1 burning a North Dakota lignite and its blend with a PRB, and Reliant Energy's 170-MW_e Portland Unit 1 burning an Eastern bituminous coal. These boilers are all equipped with an ESP. Detailed descriptions of the three host sites are listed in Table 1.

In the program, ALSTOM-PPL will demonstrate that greater than 70% of gaseous mercury in the flue gas can be captured by injection of enhanced sorbent at a feed rate significantly lower than required by standard activated carbon. ALSTOM-PPL will also collect performance data that can be used to accelerate commercialization of our mercury control technology.

Mer-Cure™ technology applied to coal-fired power generation has the potential to be a cost-effective mercury control technology for the entire range of coals (bituminous, sub-bituminous, and lignite) and, in particular, the more challenging coals (for example, PRB and lignite coal). This control technology has low-capital costs (less than \$5/kW_e). It also requires a very small amount of additives for treatment, which results in low operating costs (0.5-0.75 mills/kWh) and minimal balance-of-plant (BOP) impact. As the technology is based on oxidation and adsorption of mercury, it is also applicable to all air pollution control configurations including wet scrubber and spray dryer-ESP/baghouse units. The main focus of the project, however, is with a cold-side ESP as the particulate control device.

ALSTOM-PPL believes that our mercury control technology offers a great opportunity for utility companies to control mercury in the most cost-effective manner while minimizing any balance-of-plant impact. ALSTOM also believes that the DOE-sponsored full-scale demonstration of the technology will accelerate our commercialization effort of Mer-Cure™ technology.

Table 1. Host site, coal and emission data for the field demonstration program

	PacifiCorp	Basin Electric		Reliant Energy
Unit	Dave Johnston 1	Leland Olds 1		Portland 1
Capacity (MW_e Gross)	110	220		172
Operation	Base-loaded	Base-loaded		Cycling
NO_x and SO_2 control	No low-NO_x Low sulfur coal	No low NO_x Low sulfur coal		Low-NO_x - LNCFS No sulfur control
Air Heater	Ljungstrom	Ljungstrom + Tubular		Ljungstrom
Particulate control (SCA in ft^2/kacfm)	CS-ESP (706)	CS-ESP (320)		CS-ESP (284)
Ash utilization	Disposal	Disposal		Disposal
Coal	PRB	ND lignite; ND lignite-PRB blend		Freedom #2, Pittsburgh seam coal
Higher Heating Value As-received(lb/MMBtu)	8,608	Lignite 6617	PRB 8,071	12,889 14,933 (dry)
S in coal (%)	0.43	0.63	0.43	2.26%
Ash %	5.31	9.86	5.22	7.36%
Cl in coal (ppmwd)-dry	92 - 95			1,393
	PRB coal data	Lignite coal data		Bituminous coal data
Hg in coal (ppmwd)-dry	0.071-0.083	0.057-0.099		0.1-0.16
As-fired Hg level from Coal ($\mu g/Nm^3$)	7-9	6-10		10-16
Inlet Hg* ($\mu g/Nm^3$)	T-10.7; PM-9.1; Ox-0.2; El-1.4*	T-7.9; PM-2.0; Ox-0.1; El-5.8- March '03		T-9.1; PM-0.9; Ox-7.4; El-0.8[+]
Uncontrolled Hg Emission* Stack (Hg^T, Hg^p, Hg^{ox}, Hg^{el}) ($\mu g/Nm^3$)	T-2.7; PM < 0.13; Ox-1.2; El-1.4*	T-7.8; PM-0.0; Ox-1.4; El-6.4- March '03		T-7.5; PM-0.0003; Ox-5.2; El-2.3[+] after ESP, before scrubber
Removal Efficiency (ICR data)	8.5 – 12%	12-25%		36% for bituminous coals with CS-ESP
Carbon-in-ash	0.5-1.6%	< 0.2%		10-12%
Flue gas temp (ESP Inlet)	276°F	375°F		277°F – full load

*Unit 2 data. Unit 2 similar to Unit 1 & fires the same coal
[+]Data from 150 MWe AES-Cayuga (CE-LNCFS III with an ESP/scrubber) burning similar Pittsburgh seam coal with 2.3% S, 0.09% Cl and 0.1 ppmd Hg

EXPERIMENTAL

The four major tasks being performed for the on-going demonstration project are:

Task 1. Design, Engineering and Fabrication of the Mer-Cure™ System
Task 2. Field Demonstration
Task 3. Technology Transfer
Task 4. Program Management and Reporting.

The first two tasks will be repeated for each of the three host sites, and the others will be performed to support the entire demonstration program.

Task 1A. Design, Engineering and Fabrication of Mer-Cure™ System for PacifiCorp Campaign

During the reporting period, ALSTOM-PPL has developed and distributed a list of host site-specific information required to design the overall test plan.

ALSTOM-PPL has started designing the system architecture of Mer-Cure™ system for PacifiCorp campaign. ALSTOM-PPL is considering assembling a mobile Mer-Cure™ system that can be moved to the three test sites. The mobile Mer-Cure™ system is composed of three components mounted on a trailer: a sorbent storage system, a sorbent delivery system, and a sorbent distribution system.

The sorbent storage system being considered for the testing is a portable solid storage silo that requires a relatively small footprint and can be easily installed/uninstalled. The sorbent storage system is designed to load multiple 900-lb super-sack bags at the same time and will allow uninterrupted operation for 24 hours at a typical injection rate.

The sorbent delivery system is a variable screw feeder for metering the sorbent and an eductor for its pneumatic transport. The sorbent distribution system is a flexible hose and interconnecting pipes leading up to distribution manifolds and injection lances.

In preparation for the seven-week field testing, a site visit has been scheduled. During the visit, more site-specific information will be collected. Also, baseline measurement of the current mercury level will be measured to ensure that the mercury level is high enough for the upcoming test campaign.

Uniform distribution of sorbents into the flue gas stream is very important for good contact between the sorbents and the mercury in the flue gas stream. During the visit, ALSTOM will collect boiler design data to carry out flow modeling calculations. These flow-modeling studies will allow specific design and better determination of the location and the number of injection lances.

Task 2A. Field Demonstration for PacifiCorp Campaign

No activities for this task during the reporting period.

Task 3. Technology Transfer

No activities for the task during the reporting period.

Task 4. Project Management and Reporting

During the reporting period, ALSTOM-PPL has completed Confidentiality Agreements with all of the project team members. ALSTOM-PPL has also distributed the scope of work for review with the project team members. Draft copies of Host Site Agreement have been distributed for review and revision. The project kick-off meeting with DOE has been scheduled for early February 2005. We have executed a Host Site Agreement with Basin Electric and are in the process of completing Host Site Agreements with other host sites. We have executed a Subcontract Agreement with UND-EERC. The host sites are reviewing their respective Subcontract Agreements.

RESULTS AND DISCUSSION

No testing was performed during the reporting period.

MILESTONES AND SCHEDULE

Table 2. Schedule

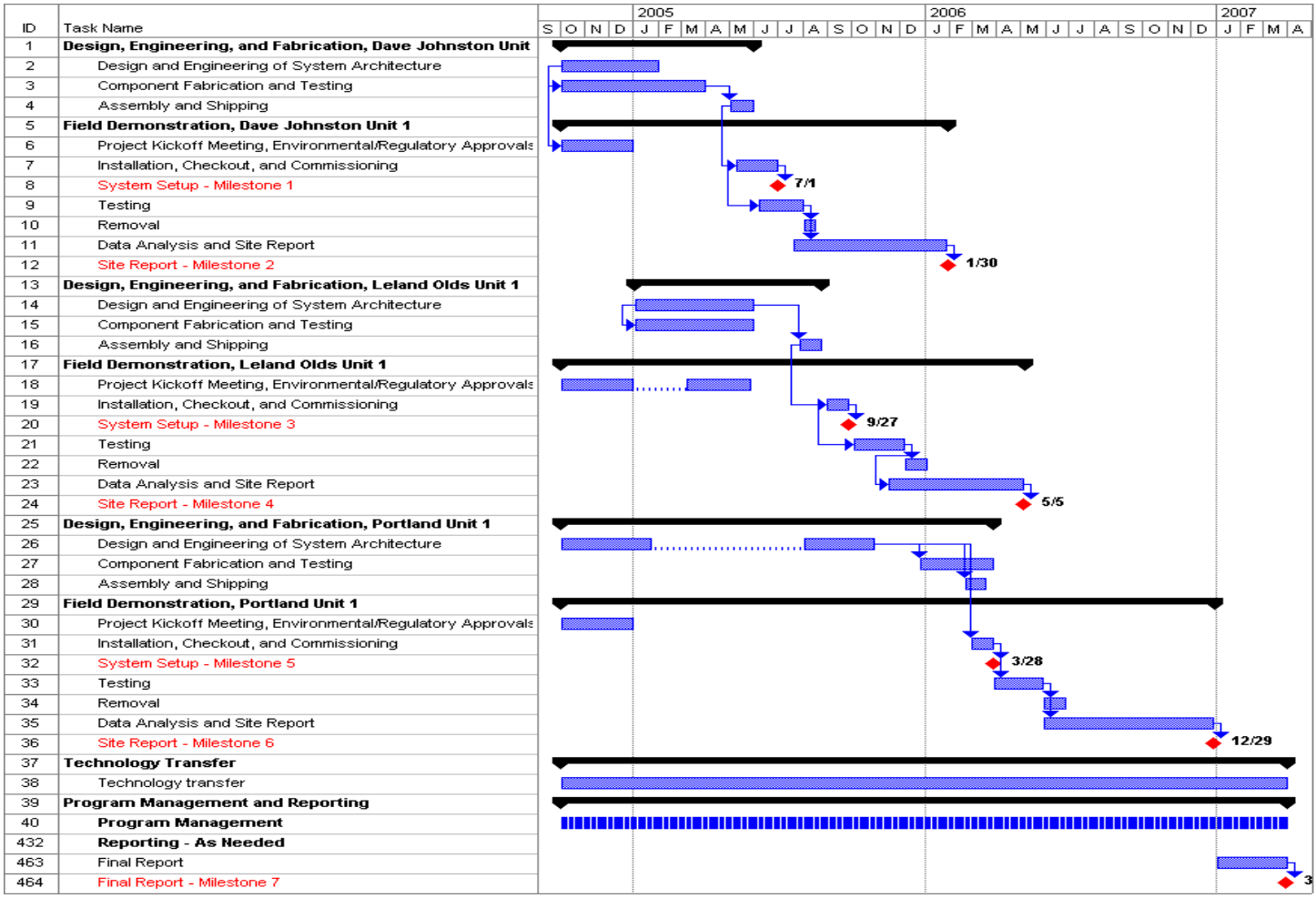

Table 3. Milestone and Deliverables

Milestone/ Deliverable	Original	Revised	Actual
1. System setup – Dave Johnston (PacifiCorp)	7/1/05		
2. Site Report – Dave Johnston (PacifiCorp)	1/30/06		
3. System setup – Leland Olds (Basin Electric)	9/27/05		
4. Site Report – Leland Olds (Basin Electric)	5/5/06		
5. System setup – Portland (Reliant)	3/28/06		
6. Site Report – Portland (Reliant)	12/29/06		
7. Final Report	3/30/07		

BUDGETS

The overall budget for this project is $ 4,980,821. The approved budget is $ 250,000. The actual amount spent to date is $ 16,000. The program is on schedule and on budget.